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SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT WE, Tsuneo Sato, a citizen of Japan residing at Kawasaki-shi, Kanagawa, Japan and Kiyoshi Kotegawa, a citizen of Japan residing at Oita-shi, Oita, Japan have invented certain new and useful improvements in

DEVICE AND METHOD FOR USER IDENTIFICATION
CHECK BASED ON USER-SPECIFIC FORMULA

of which the following is a specification : -

1 TITLE OF THE INVENTION

DEVICE AND METHOD FOR USER IDENTIFICATION
CHECK BASED ON USER-SPECIFIC FORMULA

5 BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to devices and methods for checking identification of users, an IC card for checking identification of the owner of the card, and a memory medium having program recorded therein for checking identification of a user. The present invention particularly relates to a user-identification check method, a user-identification check device, and a user identification check card, which achieve high security without imposing undue burden on users or on a system. The present invention further relates to a memory medium having a program embodied therein for achieving such a user-identification check device.

20 2. Description of the Related Art

As a result of increasing use of computers in fabric of society, checking user identification based on a computer system has begun to be widely used in various fields relating to information processing. In the event that checking of user identification errs or misuse of user identification is not prevented, ramifications are not only damages on individuals but also widespread confusion in society. Society demands a technology that achieves higher security in checking of user identification.

The scheme most widely used for user-identification check is to let a user to pick and register a pin code such as defined by 4 digits. When a user identification needs to be checked, the user enters his/her pin code, and a check is made as to whether the entered pin code and the registered pin code match. A match indicates that the user is

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1 authorized.

a) When a pin code is fixed as defined by a series of fixed digits, however, someone who sees a user entering a pin code may be able to pick up the code. This compromises security.

5 Further, users tend to select a pin code that is easy to remember for them, such as a selected portion of their phone number, the date of birth, the home address, etc. Such a tendency increases a chance of someone correctly guessing your pin number. This is also a factor to compromise security.

10 In order to obviate the drawbacks described above, Japanese Patent Laid-open Application No. 63-170764 teaches a system in which a user registers a formula and a key number. At a time of user-identification check, the system generates a time-dependent variable. A user enters a number that produces the key number when the entered number is inserted into the registered formula. The number entered by the user is compared with a number calculated by the system. If these two numbers match, the user is authorized.

15 In the user-identification-check system described above, a user registers a formula " $x + y$ " and a key number " $z_0 = 7$ ", for example. When the system presents a time-dependent variable 3 ($= x$), a user enters 4 ($= y$) that satisfies the equation " $x + y = 7$ ". Entering such a number proves that the user is an authorized user.

20 The check of user identification as described above can maintain security even when someone sneakily picks up a number that a user enters. This is because the number that the user enters is not a fixed code such as a pin code. This scheme thus provides higher security.

25 In this scheme, however, a user needs to remember both the registered formula and the key

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In the device described above, the random number is presented to the user, and the check value is obtained from the random number and the user-specific formula. Then, the check value is compared with the user-entered value that is entered by the user in response to the random number presented to the user. A match in the comparison indicates that the user is authorized. This device insures high-level security since secrecy of the user-specific formula is maintained even when someone surreptitiously picks up

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Moreover, the user needs to remember only his/her user-specific formula and nothing else.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.2 is an illustrative drawing showing an example of a computer which implements a user-identification check device of Fig.1;

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Fig.5 is a flowchart of a process of registering a password logic performed by an identification-check-data control unit of Fig.3;

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Fig.8 is an illustrative drawing showing an example of a password-logic-registration window;

1 Fig.9 is an illustrative drawing showing an
example of a password input window;

 Fig.10 is an illustrative drawing of a user-
identification check system according to another
5 embodiment of the present invention;

 Fig.11 is a flowchart of a process of
registering a password logic performed by an
interaction unit of Fig.10;

 Fig.12 is a flowchart of a process of
10 registering a password logic performed by an
identification-check-data control unit of Fig.10;

 Figs.13A and 13B is a flowchart of a process
of updating a password logic performed by the
interaction unit;

15 Figs.14A and 14B is a flowchart of a process
of updating a password logic performed by the
identification-check-data control unit;

 Fig.15 is a flowchart of a process of
checking user identification performed by the
20 interaction unit;

 Fig.16 is a flowchart of a process of
checking user identification performed by the
identification-check unit of Fig.10;

 Fig.17 is an illustrative drawing of a user-
25 identificatin-check system utilizing a user-
identification-check card according to the present
invention; and

 Figs.18A and 18B are a flowchart of a process
performed by a card-identification-check unit of Fig.17
30 when checking user identification by use of a card.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

 In the following, a principle and embodiments
of the present invention will be described with
35 reference to the accompanying drawings.

 Fig.1 is a block diagram of a user-
identification check system according to a principle of

1 the present invention.

In Fig.1, a user-identification check device 1 performs a process of checking user identification. A terminal 2 is provided for the user-identification check device 1, and provides a user with a means to interact with the user-identification check device 1.

The user-identification check device 1 according to the present invention includes a control-data unit 10, a registration/updating unit 11, a random-number generating unit 12, a selection unit 13, a calculation unit 14, and a matching unit 15.

The control-data unit 10 keeps correspondences between user IDs and formulas associated with the users. Depending on a user, a series of digits is provided in place of a formula. The registration/updating unit 11 is used for registering or updating formulas in the control-data unit 10. The random-number generating unit 12 generates a series of a predetermined number of random digits (or one digit), and presents the series of random digits to a user.

The selection unit 13 selects a formula corresponding to an indicated user ID from the control data of the control-data unit 10. The calculation unit 14 calculates a number to be used for the identification purpose by using the random number (i.e., the series of random digits) generated by the random-number generating unit 12 and the formula selected by the selection unit 13. The matching unit 15 checks whether a number entered by a user in response to the presentation of the random digits matches the number calculated by the calculation unit 14. A match indicates that the user is authorized.

The functions of the user-identification check device 1 are normally implemented via software programs running on a computer.

Fig.2 is an illustrative drawing showing an

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1 example of a computer which implements the user-
identification check device 1.

5 A computer 100 of Fig.2 includes a CPU 101, a
RAM 102, a ROM 103, a MODEM 104, a memory drive 105, an
auxiliary memory 106, and a bus 107 connecting these
elements together. A user-identification program is
stored in a remote storage 108 connected to the modem
104 via a communication line, and/or is stored in a
memory medium 109 such as a floppy disk, a CD-ROM, a
10 memory card, or the like. The user-identification
program is loaded to the computer 100 from the remote
storage 108 via the modem 104 or from the memory medium
109 via the memory drive 105. The loaded program may
be stored in the auxiliary memory 106 for subsequent
15 loading to the RAM 102, or may be directly stored in
the RAM 102. The CPU 101 executes the user-
identification program stored in the RAM 102 by using
an available memory space of the RAM 102 as its work
area, and performs functions of the
20 registration/updating unit 11, the random-number
generating unit 12, the selection unit 13, the
calculation unit 14, and the matching unit 15. The
auxiliary memory 106 serves as the control-data unit
10. Further, the ROM 103 stores programs therein for
controlling basic operations of the computer 100.
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Not only the configuration of Fig.1 may be
implemented on the computer 100 of Fig.2, but also
other configurations of embodiments, which will be
described later, may be implemented on a computer such
30 as the computer 100 shown in Fig.2.

With reference to Fig.1 again, the
registration/updating unit 11 receives a formula (or a
series of digits) entered in the terminal 2, and
registers the formula and a relevant user ID as a pair
35 in the control-data unit 10. When there is a request
for updating a formula registered in the control-data
unit 10, the registration/updating unit 11 receives a

A time-dependent variable such as that which changes from 1 to 12 according to the current month may be included in the formula. In such a case, the calculation unit 14 uses the time-dependent variable and the random number generated by the random-number

The user-identification check scheme of Japanese Patent Laid-open Application No. 63-170764 as previously described requires a user to remember both a formula and a key number. On the other hand, the present invention requires the user to remember only his/her formula. Further, the scheme of the above document demands that the system store formulas and key numbers in its memory. The present invention, on the other hand, suffice only if the system stores formulas in its memory. The present invention thus provides high security without imposing undue burden on the users or on the system.

1 Further, according to the present invention,
a user-identification-check card may be provided for a
user, and stores therein the user's formula. This
configuration also achieves high security.

5 In the following, embodiments of the present
invention will be described with the accompanying
drawings.

Fig.3 is a block diagram of an information
processing device which implements user-identification
10 check according to an embodiment of the present
invention.

An information processing device 20 of Fig.3
includes a display unit 21 such as a CRT, an input unit
22 such as a keyboard and a mouse, an identification-
15 check-data storage unit 23, an identification-check-
data control unit 24, and an identification-check unit
25. The identification-check-data storage unit 23
stores therein data that is necessary for user-
identification check. The identification-check-data
20 control unit 24 attends to registration and updating of
the identification-check data stored in the
identification-check-data storage unit 23, and is
implemented via a program installed through a floppy
disk, a communication line, or the like. The
25 identification-check unit 25 performs a user-
identification-check process by referring to the
identification-check data stored in the identification-
check-data storage unit 23, and is implemented via a
program installed through a floppy disk, a
30 communication line, or the like.

Fig.4 is an illustrative drawing showing an
example of the identification-check data stored in the
identification-check-data storage unit 23.

As shown in the figure, the identification-
35 check-data storage unit 23 stores paired user IDs and
password logics where the password logics are
registered by respective users. Depending on user

1 preference, a given password logic may be a simple
personal identification number.

The password logics generally define
formulas, which are applied to random digits generated
5 by the identification-check unit 25. In the example
shown in Fig.4, a user having a user ID "000005"
registered a password logic that calculates "A-B" when
a 4-digit random number ABCD is presented. On the
other hand, a user having a user ID "000004" registered
10 a pin code "5348" rather than a formula, so that this
pin code is stored in the identification-check-data
storage unit 23.

In the example of Fig.4, password logics are
shown by using a general form of formula representation
15 for the sake of simplicity. In practice, however, the
password logics may be stored by using a special form
of representation such as the Reversed Polish Notation.

According to the Reversed Polish Notation,
the formulas shown in Fig.4 are represented as follows:

20 $10 \times A \rightarrow 10A^*$;
 $A \times A \rightarrow AA^*$;
 $A \div B \rightarrow AB/$;
 $A - B \rightarrow AB-$;
 $(B-A) + C \rightarrow BA-C+;$ and
25 $((A - B) \times 5) \div 2 \rightarrow AB-5*2/.$

Use of such a form of representation makes it more
difficult to decipher codes, thereby enhancing level of
security.

Fig.5 is a flowchart of a process of
30 registering a password logic performed by the
identification-check-data control unit 24.

At a step ST1, upon a request for
registration of a password logic, the identification-
check-data control unit 24 displays a password-logic-
35 registration window on the display unit 21. Fig.8 is
an illustrative drawing showing an example of the
password-logic-registration window.

In this manner, the identification-check-data control unit 24 registers a user-defined password logic in the identification-check-data storage unit 23 when a user issues a request for password-logic registration.

15 At a step ST1, upon a request for updating a password logic, the identification-check-data control unit 24 displays a password-logic-registration window on the display unit 21 as shown in Fig.8.

At a step ST3, the user enters an old password logic in the password-logic-registration window.

At the step ST5, an old password logic registered in the identification-check-data storage unit 23 is obtained from the identification-check-data storage unit 23.

At a step ST6, a check is made as to whether the old password logic entered at the step ST3 matches the old password logic obtained at the step ST5. If there is no match, it is ascertained that the user does not know the correct password logic, so that the procedure ends without authorizing the updating of

1 password logic.

If the step ST6 finds that the two password logics match, the procedure goes to a step ST7, where the user enters a new password logic.

5 At a step ST8, a check is made as to whether the user operates an END button (i.e., a button for finishing a registration process). If a CANCEL button is operated, the procedure comes to an end. If the END button is operated, the procedure goes to a step ST9.

10 At the step ST9, the identification-check-data control unit 24 updates the old password logic with the new password logic in the identification-check-data storage unit 23. The procedure then comes to an end.

15 In this manner, the identification-check-data control unit 24 updates a password logic stored in the identification-check-data storage unit 23 upon a user request for updating a password logic only if the user knows the old password logic stored in the
20 identification-check-data storage unit 23.

According to the flowcharts of Figs.5 and 6, the identification-check-data storage unit 23 registers paired user IDs and password logics (or pin numbers) in the identification-check-data storage unit 23.

25 Figs.7A and 7B is a flowchart of a process of checking user identification performed by the identification-check unit 25.

At a step ST1, upon a user request for identification check, the identification-check unit 25
30 generates a four-digit random number as represented by ABCD.

At a step ST2, the identification-check unit 25 displays a password-input window on the display unit 21, and presents the generated random number in the
35 window. If a random number "4361" is generated, for example, this number is presented to a user. Fig.9 is an illustrative drawing showing an example of the

1 password input window.

At a step ST3, the user enters a user ID and a password.

The password entered by the user is calculated by applying the password logic registered in the identification-check-data storage unit 23 to the digits A, B, C, and D of the random number generated by the identification-check unit 25. If a random number "4361" is generated by the identification-check unit 25, and if the user has a registered password logic "A+B+C+D", the user calculates "4+3+6+1" to obtain a password "14". The user then enters the obtained password in the password-input window.

15 If a password logic has a division operation
that has "0" as its denominator, the identification-
check unit 25 substitutes "0" for the result of the
division operation. The user has to follow this rule
to obtain a password. Further, if a password logic has
a division operation that produces a remainder, the
20 identification-check unit 25 discards digits below a
decimal point. The user has to obey this rule when
obtaining a password. Moreover, the identification-
check unit 25 obtains an absolute value of a result of
the password logic operation when the result of the
25 password logic operation becomes negative. The user
needs to respect this rule as well. The rules
described above are merely an example, and other rules
may be set forth when appropriate.

When the user has a pin code registered in the identification-check-data storage unit 23, the user enters the pin code as a password in the password-input window.

At a step ST4, a check is made as to whether the user ID entered at the step ST3 is found as a registered user ID in the identification-check-data storage unit 23.

If the step ST4 finds that the user ID is a

1 registered user ID, at a step ST5, a password logic
registered for the user is obtained by referring to the
identification-check-data storage unit 23.

5 At a step ST6, the random number generated at
the step ST1 is broken down into four separate digits
A, B, C, and D.

At a step ST7, the four digits are inserted
into the password logic obtained at the step ST5 to
produce a value corresponding to the password entered
10 by the user.

In so doing, the identification-check unit 25
substitutes "0" for a result of a division operation if
the division operation in the password logic has "0" as
its denominator, and discards digits below a decimal
15 point if a division operation in the password logic
produces a remainder. Moreover, the identification-
check unit 25 obtains an absolute value of a result of
the password logic operation when the result of the
password logic operation becomes negative, and outputs
20 a pin code if the pin code is defined in place of a
password logic.

At a step ST8, the password entered at the
step ST3 is compared with the value obtained at the
step ST7.

25 At a step ST9, a check is made as to whether
the comparison indicates a match. If there is a match,
the procedure goes to a step ST10, where the
identification-check unit 25 outputs a signal (data)
indicative of authorization of the user. In response,
30 a program for predetermined business processing starts
operation thereof. This ends the procedure.

If the step ST4 finds that the entered user
ID is not a registered user ID, or if the step ST9
finds that the entered password does not match the
35 obtained value, the procedure goes to a step ST11 of
Fig.7B.

At the step ST11, a check is made as to

1 whether the user-identification check has been
attempted a predetermined number of times. If the
predetermined number of attempts have been made, the
procedure goes to a step ST12, where the
5 identification-check unit 25 displays a message
indicating a wrong user identification on the display
unit 21. This ends the procedure.

If the step ST11 finds that the user-
identification check has not been attempted the
10 predetermined number of times, the procedure goes to a
step ST13, where a count of the number of attempts is
increased by one. Then, the procedure goes back to the
step ST1 to repeat the user-identification-check
process as described above.

15 In this manner, the identification-check unit
25, upon a user request for identification check,
obtains a value by using a user-defined password logic
registered in the identification-check-data storage
unit 23 and a random number, and compares the obtained
20 value with a password that is entered by the user in
response to the random number presented to the user,
thereby making a proper user-identification check.

Use of such user-identification check insures
high-level security even if someone surreptitiously
25 picks up a number that the user enters. The user needs
to remember only his/her password logic and nothing
else. Likewise, the system needs to store only a
password logic for each user. High-level security is
thus achieved without imposing excessive burden on the
30 user or on the system.

Further, the embodiment described above is
applicable to a case where conventional pin codes are
used as an option. In this manner, this embodiment can
cope with various user preferences including use of a
35 pin code if the user so wishes.

Fig.10 is an illustrative drawing of a user-
identification check system according to another

1 software program installed from a floppy disk, CD-ROM,
or the like, or installed from a remote storage via a
communication line.

Fig.11 is a flowchart of a process of
5 registering a password logic performed by the
interaction unit 43.

At a step ST1, upon a request for
registration of a password logic, the interaction unit
43 of the distribution terminal 40 displays a password-
10 logic-registration window on the display unit 41 as
shown in Fig.8.

At a step ST2, a user enters a user ID in the
password-logic-registration window.

At a step ST3, a user enters a user-defined
15 password logic in the password-logic-registration
window. This password logic is of the same type as
that used in the previous embodiment.

At a step ST4, a check is made as to whether
the user operates an END button (i.e., a button for
20 activating a registration process). If a CANCEL button
is operated, the procedure comes to an end. If the END
button is operated, the procedure goes to a step ST5.

At the step ST5, the interaction unit 43
sends the entered user ID and password logic to the
25 identification-check-data control unit 32 of the
identification-check server 30.

As will be described later in detail, the
identification-check-data control unit 32 returns a
message in response to the transmission of the user ID
30 and the password logic, and the message indicates
whether registration of the password logic is
completed.

At a step ST6, a check is made as to whether
this return message is received from the
35 identification-check-data control unit 32. When the
message is received, the procedure goes to a step ST7.

At the step ST7, a check is made as to

1 whether the message indicates that registration of the
password logic is completed.

If the step ST7 finds that registration of
the password logic is completed, the procedure comes to
5 an end. If the step ST7 finds that registration is not
completed, at a step ST8, the interaction unit 43
presents a message on the display unit 41 to indicate
that registration of the password logic has failed.
Then, the procedure comes to an end.

10 Fig.12 is a flowchart of a process of
registering a password logic performed by the
identification-check-data control unit 32.

At a step ST1, upon a request by the
interaction unit 43 to register a password logic, the
15 identification-check-data control unit 32 of the
identification-check server 30 receives the user ID and
the password logic from the interaction unit 43.

At a step ST2, a check is made as to whether
a user indicated by the user ID has a password logic
20 already registered in the identification-check-data
storage unit 31. If there is an already registered
password logic, the procedure goes to a step ST3, where
the identification-check-data control unit 32 sends a
message to the interaction unit 43 to indicate that
25 registration of the password logic cannot be completed.
Then, the procedure comes to an end.

If the step ST2 finds that the user indicated
by the user ID does not have a password logic already
registered in the identification-check-data storage
30 unit 31, the procedure goes to a step ST4.

At the step ST4, the received password logic
and the received user ID are registered as a pair in
the identification-check-data storage unit 31.

At a step ST5, the identification-check-data
35 control unit 32 sends a message indicative of
completion of the registration to the interaction unit
43.

1 password logic is acceptable.

If the step ST7 finds that updating of the password logic is unacceptable, the procedure goes to a step ST8, where a message is presented on the display unit 41 to indicate that updating of the password logic is not acceptable. Then, the procedure comes to an end.

If the step ST7 finds that updating of the password logic is acceptable, the procedure goes to a step ST9, where the user enters a new password logic for the updating purpose.

At a step ST10 of Fig.13B, a check is made as to whether the user operates an END button (i.e., a button for activating a registration process). If a CANCEL button is operated, the procedure comes to an end. If the END button is operated, the procedure goes to a step ST11.

At the step ST11, the interaction unit 43 sends the user ID and the new password logic entered at the step ST9 to the identification-check-data control unit 32.

As will be described later in detail, the identification-check-data control unit 32 returns a message in response to the transmission of the user ID and the new password logic, and the message indicates whether registration of the new password logic is completed.

At a step ST12, a check is made as to whether this return message is received from the identification-check-data control unit 32. When the message is returned, the procedure comes to an end.

Figs.14A and 14B is a flowchart of a process of updating a password logic performed by the identification-check-data control unit 32.

At a step ST1, upon a request by the interaction unit 43 to update a password logic, the identification-check-data control unit 32 of the

1 identification-check server 30 receives the user ID and
the old password logic from the interaction unit 43.

At a step ST2, the identification-check-data
control unit 32 refers to the identification-check-data
5 storage unit 31 to obtain a password logic
corresponding to the received user ID.

At a step ST3, a check is made as to whether
the password logic obtained at the step ST2 matches the
password logic received at the step ST1. If there is
10 no match, the procedure goes to a step ST4, where a
message indicative of denial of the updating request is
send to the interaction unit 43. The procedure comes
to an end.

If the step ST3 finds that the two password
15 logics match, the procedure goes to a step ST5, where a
message indicative of acceptance of the updating
request is sent to the interaction unit 43.

As previously described, the interaction unit
43 responds to the message indicative of acceptance of
20 the updating request sent from the
identification-check-data control unit 32 by sending
the user ID and a new password logic.

At a step ST6, a check is made as to whether
the user ID and a new password logic are received from
25 the interaction unit 43. When they are received, the
procedure goes to a step ST7 of Fig.14B.

At the step ST7 of Fig.14B, the
identification-check-data control unit 32 updates the
old password logic indicated by the received user ID
30 with the received new password logic in the
identification-check-data storage unit 31.

At a step ST8, the identification-check-data
control unit 32 sends a message indicating completion
of a password-logic updating process to the interaction
35 unit 43. This ends the procedure.

In this manner, the interaction unit 43 and
the identification-check-data control unit 32 interact

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1 with each other via the network 50 when a user requests
updating of a password logic, and collaboratively
update the password logic in the identification-check-
data storage unit 31 only if the user knows the old
5 password logic.

Based on the procedures shown as flowcharts
in Fig.11 through Figs.14A and 14B, user IDs and
password logics (or pin codes) associated with the user
IDs are stored in the identification-check-data storage
10 unit 31 of the identification-check server 30.

Based on this identification-check data
stored in the identification-check-data storage unit
31, the interaction unit 43 and the identification-
check unit 33 interact with each other via the network
15 50 to perform a user-identification check when a user
requests a check of user identification.

Fig.15 is a flowchart of a process of
checking user identification performed by the
interaction unit 43.

20 At a step ST1, upon a user request for
identification check, the interaction unit 43 of the
distribution terminal 40 generates a four-digit random
number as represented by ABCD.

At a step ST2, the identification-check unit
25 25 displays a password-input window on the display unit
21 as shown in Fig.9, and presents the generated random
number in the window. If a random number "4361" is
generated, for example, this number is presented to a
user.

30 As will be described later, the random number
generated at this step does not have to be a four-digit
random number, but can be comprised of only one digit,
two digits, or three digits. By the same token, the
random number may be comprised of a larger number of
35 digits more that four.

At a step ST3, the user enters a user ID and
a password.

1 The password entered by the user is
calculated by applying the password logic registered in
the identification-check-data storage unit 31 to the
digits A, B, C, and D of the random number generated by
5 the interaction unit 43. If a password logic has a
division operation that has "0" as its denominator, the
user obtains the password by substituting "0" for the
result of the division operation. Further, if a
password logic has a division operation that produces a
10 remainder, the user obtains the password by discarding
digits below a decimal point. Moreover, the user
obtains the password by calculating an absolute value
of a result of the password logic operation when the
result of the password logic operation becomes
15 negative. When the user has a pin code registered in
the identification-check-data storage unit 31, the user
enters the pin code as the password in the password-
input window.

 At a step ST4, the interaction unit 43 sends
20 the random number generated at the step ST1 and the
user ID and password entered at the step ST3 to the
identification-check unit 33.

 As will be described later in detail, the
identification-check unit 33 returns a message in
25 response to the transmission of the random number, the
user ID, and the password, and the message indicates
whether the user is authorized by entering the
password.

 At a step ST5, a check is made as to whether
30 this return message is received from the
identification-check unit 33. When the message is
received, the procedure goes to a step ST6.

 At the step ST6, a check is made as to
whether the return message indicates that user
35 authorization is completed.

 If the step ST6 finds that the message
received from the identification-check unit 33

1 corresponding to the user ID is obtained from the
identification-check-data storage unit 31.

At a step ST4, the random number received at
the step ST1 is broken down into four separate digits
5 A, B, C, and D.

At a step ST5, the four digits are inserted
into the password logic obtained at the step ST3 to
produce a value corresponding to the password entered
by the user.

10 In so doing, the identification-check unit 33
substitutes "0" for a result of a division operation if
the division operation in the password logic has "0" as
its denominator, and discards digits below a decimal
point if a division operation in the password logic
15 produces a remainder. Moreover, the identification-
check unit 33 obtains an absolute value of a result of
the password logic operation when the result of the
password logic operation becomes negative, and outputs
a pin code if the pin code is defined in place of a
20 password logic.

At a step ST6, the password received at the
step ST1 is compared with the value obtained at the
step ST5.

At a step ST7, a check is made as to whether
25 the comparison indicates a match. If there is a match,
the procedure goes to a step ST8, where the
identification-check unit 33 sends a message indicative
of completion of user authorization to the interaction
unit 43. This ends the procedure.

30 If the step ST2 finds that the received user
ID is not registered in the identification-check-data
storage unit 31, or if the step ST7 finds that the
password does not match the obtained value, the
procedure goes to a step ST9.

35 At the step ST9, the identification-check
unit 33 sends a message indicating denial of user
authorization to the interaction unit 43. This ends

1 the random number and the user-defined password logic,
and checks if the user-entered password matches the
system-generated value, thereby checking a user
identification.

5 According to this principle, the present
invention may use a magnetic stripe card or an IC card
as a user-identification-check card, which record
therein a user-defined password logic instead of a pin
code.

10 A conventional user-identification-check card
such as a magnet stripe card or an IC card records
therein a user ID and a pin code. In contrast, the
user-identification-check card according to the present
invention records therein a user ID and a user-defined
15 password logic.

Fig.17 is an illustrative drawing of a user-
identification-check system utilizing a user-
identification-check card according to the present
invention.

20 As shown in the figure, an IC card 60 of the
present invention includes a memory unit 600 and a
random-number generation unit 601. The memory unit 600
stores therein a user ID and a user-defined password
logic.

25 The IC card 60 is inserted into an IC-card
reader 70 connected to the distribution terminal 40.
The distribution terminal 40 includes a card-
identification-check unit 44 for performing a user-
identification check by using the password logic
30 recorded in the IC card 60.

Figs.18A and 18B are a flowchart of a process
performed by the card-identification-check unit 44 when
checking user identification by use of a card. With
reference to these figures, a check of user
35 identification based on the IC card 60 will be
described below.

At a step ST1, upon a request for user-

1 identification check with respect to the IC card 60,
the card-identification-check unit 44 of the
distribution terminal 40 reads a user ID and a password
logic from the IC card 60.

5 At a step ST2, the card-identification-check
unit 44 receives a random number that is generated by
the random-number generation unit 601 of the IC card
60.

10 At a step ST3, the card-identification-check
unit 44 displays a password-input window as shown in
Fig.9, and presents the random number to the user. For
example, a random number "4361" is generated and
presented in the password-input window.

15 At a step ST4, the user enters a password in
the password-input window.

20 The user calculates the password by applying
the password logic recorded in the IC card 60 to the
digits A, B, C, and D of the random number generated by
the random-number generation unit 601. If a password
logic has a division operation that has "0" as its
denominator, the user obtains the password by
substituting "0" for the result of the division
operation. Further, if a password logic has a division
operation that produces a remainder, the user obtains
25 the password by discarding digits below a decimal
point. Moreover, the user obtains the password by
calculating an absolute value of a result of the
password logic operation when the result of the
password logic operation becomes negative. When the
30 user has a pin code recorded in the IC card 60, the
user enters the pin code as the password in the
password-input window.

35 At a step ST5, the random number received at
the step ST2 is broken down into four separate digits
A, B, C, and D.

At a step ST6, the four digits are inserted
into the password logic obtained at the step ST1 to

1 produce a value corresponding to the password entered
by the user.

At a step ST7, the password entered at the
step ST4 is compared with the value obtained at the
5 step ST6.

At a step ST9, a check is made as to whether
the comparison indicates a match. If there is a match,
the procedure goes to a step ST9, where the card-
identification-check unit 44 outputs a signal (data)
10 indicative of authorization of the user. In response,
a program for business processing starts operation
thereof. This ends the procedure.

If the step ST8 finds that the entered
password does not match the obtained value, the
15 procedure goes to a step ST10.

At the step ST10, a check is made as to
whether the user-identification check has been
attempted a predetermined number of times. If the
predetermined number of attempts have been made, the
20 procedure goes to a step ST11 of Fig.18B, where the
card-identification-check unit 44 displays a message
indicating a wrong user identification on the display
unit 41. This ends the procedure.

If the step ST10 finds that the user-
25 identification check has not been attempted the
predetermined number of times, the procedure goes to a
step ST12, where a count of the number of attempts is
increased by one. Then, the procedure goes back to the
step ST1 to repeat the user-identification-check
30 process as described above.

In this manner, the configuration described
above utilizes a user-identification-check card such as
a magnetic stripe card or an IC card which records
therein a user-defined password logic. This
35 configuration obtains a value from a random number and
a user-defined password logic recorded in the user-
identification-check card, and compares the obtained

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1 value with a password that is entered by the user in
response to the random number presented to the user.
This achieves a proper user-identification check.

Such a configuration insures high-level
5 security since secrecy of password logic is maintained
even when someone surreptitiously picks up a number
that the user enters.

In the configuration of Fig.17, the IC card
60 is equipped with the random-number generation unit
10 601. Alternatively, a mechanism for generating a
random number may be provided in the card-
identification-check unit 44.

In the embodiments described above, a
password logic is applied to randomly generated digits.
15 In addition to such digits, variables that can be
uniquely determined by users or the system may be used
as well. Such variables include date information, time
information, etc.

For example, a variable ranging from 1 to 12
20 corresponding to respective months from January to
December may be used, and/or a variable ranging from 0
to 24 corresponding to 0:00 hours to 24:00 hours may be
employed. Such a variable may be incorporated in the
password logic in addition to random digits. For
25 example, a password logic may be represented as "(A -
B) + n" where n represents the variable as described
above.

As described hereinbefore, the present
invention registers a user-defined password logic, and
30 generates a random number to be presented to the user.
The present invention then obtains a value from the
random number and the user-defined password logic, and
compares the obtained value with a value that is
entered by the user in response to the random number
35 presented to the user. This achieves a proper user-
identification check. The present invention insures
high-level security since secrecy of password logic is

